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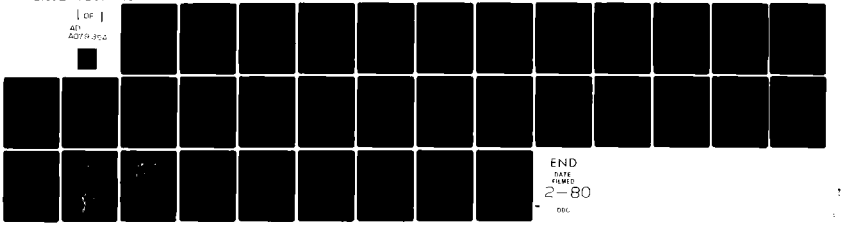

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"INCIDENCE STUDY OF SCHISTOSOMIASIS IN EGYPTIAN CHILDREN UTILIZING COMBINED CLINICAL, IMMUNOLOGICAL AND PARASITOLOGICAL PARAMETERS"

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A COMPARATIVE STUDY OF THE PREVALENCE AND MORBIDITY OF SCHISTOSOMIASIS HAEMATOBIUM AND S.MANSONI IN EGYPTIAN CHILDREN

With special reference to the relationship to the irrigation system

Technical Objectives

The prevalence and morbidity of S. haematobium and S. mansoni infection were compared in Egyptian children in matched age groups. The relationship of the prevalence to the irrigation system was investigated as well. It was found to have a lower rate in areas which had till recently a basin system of irrigation, than those with perennial irrigation. The public health implication of this difference is obvious after the construction of the High Dam.

The investigation was carried out on an approximation of 10% of the pediatric age group of the areas examined, with a total of 953 children with S. haematobium and 835 with S. mansoni infection. A cross-sectional study of the prevalence and intensity of both S. haematobium and S. mansoni infections was compared and correlated with morbidity as determined by standard medical examination.

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A. 1

S. mansoni infection as determined by quantitative Kato thick smears had an over all prevalence of 48.3%; the infection was detected as early as 3 years of age.

Diagnosis of S. haematobium infection and determination of its heaviness were done by the Nucleopore technique. The youngest age infected was found to be 9½ months. The general prevalence was 46.5%.

The heaviness of infection was more marked in S. mansoni and in the older age groups. Gastrointestinal symptoms were common with S. mansoni infection and urinary symptoms with S. haematobium. The difference was statistically significant. Hepatosplenomegely occured more frequently in those heavily infected with S. mansoni. In the same group, the haemoglobin level and nutritional status were more affected. Associated other parasitic infections were also more prevalent.

APPROACH

Schistosomiasis infection has a long history in Egypt dating back to the ancient Egyptian period[1]. The ecological concept of schistosomiasis suggests that in most endemic areas men and women of all ages who are in frequent contact with water that contains relatively high densities of cercariae, have a constant uptake of worms i.e. there is an ample opportunity for continual infection[2]. Epidemiologic surveys in many endemic areas have revealed that there are peaks of prevalence and intensity of infection in the younger members of the population at risk[3,4,5,6]. Infection with S. haematobium has been reported to occur in young age as early as 14 month old infants[3]. However, the intensity and age-prevalence in an endemic area depends on water contact and exposure pattern. The change of the irrigation system in some parts of Egypt after the construction of Asswan High Dam from basin to perennial, is expected to affect the prevalence of schistosomiasis[7]. Most previous epidemiological studies dealt with either S. mansoni or S. haematobium alone. The present study was carried out in two areas, one in upper Egypt known to be endemic for S. haematobium infection and the other in lower Egypt with an endemic

S. mansoni. A cross sectional study of the prevalence in both areas was compared and correlated to morbidity and nutritional status.

MATERIALS AND METHODS

The subjects of the present study were chosen from two different areas, Menia governorate in Upper Egypt, known to be endemic for S. haematobium and Menoffia governorate in Lower Egypt with S. mansoni endemicity (Fig. 1.). Menia governorate (2,055,739 individuals) is one of the main governorates of Upper Egypt (Fig. 2) in which irrigation has been recently changed in some of its areas from basin to perennial system after the construction of Asswan High Dam. Four areas were chosen for the study: Towa, Talla, Saft El Khammar and Touch El Kheil. In the first three areas, the system of irrigation is perennial, while in the last one, it has been recently changed from a basin to a perennial system. The population census in these four villages is: 7514, 13883, 7117 and 6235. respectively. The pediatric age group examined (0 to 12 years), constitutes 33.0% of the total population. Menofia governorate (1,710,982 Individuals) lies in Lower Egypt between the two main Nile branches (Fig. 3) with a perennial system of irrigation. Five areas were

studied: Tanbady, Mostay, Beleig, Zoer and Meet Abu Sheiha. The population census in these areas are 6388 , 6753 , 4267 , 4937 , and 4629 respectively. 31.6% of the total population are in the pediatric age group examined (6 months to 12 years).

The areas studied in the two governorates were selected to have the same socioeconomic standards. Most of the inhabitants work as farmers. The housing was mainly constructed of mud and mudbrick, near the agricultural area and canals (Figs 2 & 3).

As a prerequisite to the study, collection of baseline information was made following census and enumeration of each areas' inhabitants. A representative sample from each village was chosen to constitute about 10% of the pediatric age group. The subjects were selected by choosing every tenth house in the village and every tenth name for school children. Due to the free-primary school education which starts at six years, there was no socioeconomic bias in the sampling. A total of 835 children were examined from Menoffia governorate. From Menia governorate 953 children were examined from the three areas with perrenial irrigation and 200 children from the village which changed its system of irrigation from basin to perrenial.

The children were categorized into four age groups (table 1.) Visits were arranged to the health units for clinical and laboratory examination of the first two preschool age groups, while the older two age groups were examined at School. A questionnaire to the child or his mother concerning the major signs or symptoms attributable to schistosoma infection was analysed. Each individual included in the study was then examined for weight, height, mid upper arm muscle circumference and triceps skin fold thickness. The weight/age/height was calculated and compared with standards[8]. Complete physical examination was then performed. Hemoglobin was measured by the cyanmethemoglobin method.

Urine and stool samples were then collected. For urine, 2-hour samples following 11 a.m. were collected. Special arrangements were done for young infants to collect urine in plastic bags. This period of collection was chosen because several reports have shown a diurnal cycle in counts of ova in the urine, with the peak near noon[9-13]. The collected urine samples were well mixed and 10 ml were used to examine for, and count S. haematobium eggs by the nuclepore technique[14].

For stool examination, a sample was collected from every child after clinical examination. Stool examination and egg count were done by the modified Kato thick smear technique where a 50 mg of feces measured on a volumetric basis were examined[15]. This sample was considered a representative one since it was shown that S. mansoni eggs are usually homogenously distributed in stools[16,17]. Previous reports stated that statistical analysis showed no significant difference between the readings of one or two samples[15].

The infected children with S. haematobium or S. mansoni were classified on the basis of their egg counts into mild, moderate and heavily infected groups. For S. haematobium eggs, the representative counts for these groups were: 1 to 10, 15 to 30 and 35 or more eggs/ml urine respectively. For S. mansoni the counts were 1 to 75, 100 to 300 and 400 or more eggs/gm feces respectively.

The examined children in Menia governorate were classified into two groups: those from areas with perennial irrigation, and those from the area where the system of irrigation had been recently changed from basin to perennial. The first group was used to evaluate the prevalence and intensity of infection as compared to

children from Menofia governorate, while the second group was used to evaluate the effect of the irrigation system on the prevalence of schistosoma infection.

RESULTS

In Menia governorate, the general prevalence of S. haematobium among the examined children from areas with old perrenial irrigation was 46.5%. In the area with previous basin irrigation, the prevalence was shown to be 6.0%./ (Table 1) No S. mansoni eggs were detected in that area. The prevalence of S. haematobium eggs in stools were 2.2% and zero respectively. The youngest infected age was 9.5 months; detected in Towa village. The prevalence increased with age groups (table 2) and the peak was between 8 and 10 years old (Fig. 1).

In Menoffia governorate, the general prevalence of S. mansoni infection was 48.3 and the youngest age infected was 3 years. The prevalence of S. haematobium alone in this area was 12.1%, and as a mixed infection with S. mansoni was 6.3%. The peak prevalence for S. mansoni was between 7 and 11 years old. Both sexes were equally affected with S. haematobium and S. mansoni but the prevalence was higher in males than females after 10 years age.

The intensity of infection as graded by egg counts in the different age groups is presented in table 3 where is was found to increase with age. S. mansoni infection was present with a higher intensity specially in the older age groups.

In table 4, associated parasitic infections were present with a high prevelence. The commonest was Entrobius followed by Ascaris and Giardiasis, then H. nana and Ancylostoma. The prevalence of Ancylostoma infection was higher with S. haematobium infection than with S. mansoni, while an inverse relation was observed for Ascaris infection.

The anthropometric measurements and hemoglobin level in infected children of different age groups are presented in table 5. The data shows that it is the hemoglobin level and skin fold thickness which were mainly affected, specially with S. mansoni infection. Cases with S. mansoni infection only or S. haematobium only were included in the comparison of the anthropometric measurements and hemoglobin level. Mixed S. mansoni and S. haematobium were excluded.

Table 6 compares the prevalence of clinical signs and symptoms in children with S. haematobium or S. mansoni infection. Gastrointestinal symptoms were mainly associated with S. mansoni infection, while

urinary symptoms were mainly present with S. haematobium infection. The positive clinical findings in infected children (presented as per cent affected), demonstrates the higher prevalence of hepatosplenomaly and deficiency signs with S. mansoni than S. haematobium infection.

DISCUSSION

The endemicity of S. haematobium and S. mansoni, separately, in two areas of the same geographic distribution offers a unique opportunity to gain comparative information on their prevalence and morbidity. Divergent findings regarding both infections, reflect differences in geographic areas and populations studied. In the current investigation, the pediatric age group was chosen for study as it represents the period of early uncomplicated infection with active oviposition. A cross-sectioned study of the pediatric age group was taken to represent the sequelae of schistosoma infection in children. It was proved that a study of an entire population at one instant in time can be substituted for a study of a single age group over an extended period of time provided that the population is susceptible, not migrating and that the forces of infection do not vary significantly.[18] These factors are applicable in the present study.

In Menia governorate, the prevalence of S. haematobium differed markedly in areas with old perennial irrigation than in the area which had, till recently, basin irrigation. The latter had a marked lower prevalence, at all age periods (table 1). Similar but lower prevalences were reported from areas which still have basin irrigation in Egypt[7,19,20]. In the present study, all areas chosen from Menia governorate had similar socioeconomic status, with the mode of irrigation as the only variable. Such differences confirm the close relation of the system of irrigation to schistosoma prevalence and focus the light on the importance of establishing preventive measures when changing the system of irrigation.

Infection with S. haematobium was detected at a younger age period than S. mansoni (Fig. 1); S. haematobium eggs were detected in an infant 9½ months old, while the earliest infection with S. mansoni was detected in a child 3 years old. This difference could be due to the easier technique of collecting urine in plastic bags than stools at that young age, or to the early and more frequent exposures to the river water due to the higher atmospheric temperature in Upper Egypt. S. mansoni cercariae were found to take a longer time for complete skin penetration and even can be destroyed if the skin dries naturally before they have

penetrated[21]. The entire process from cercarial skin penetration to oviposition takes three to ten weeks. This means that infection was acquired at seven months old. Infection at that age period is passive depending on the sanitary habbits of the mother. The youngest age infected in previous reports was 14 months in Egypt[3] and 2 years in East Africa[22] and in Ibadan[23], which suggests a high vulnerability to infection at that young age, even with few exposures. Epidemiologic surveys in many endemic areas have revealed that there are peaks of prevalence and intensity of infection in the younger members of the population at risk. The prevalence of S. haematobium infection in the present survey had an earlier peak than S. mansoni infection, while the latter showed a more sharp rise (Fig. 1). In many endemic areas peak prevalence of infection occurs between 10 and 20 years of age, and declines thereafter for S. haematobium while in S. mansoni there is little decline[4,5]. In Egypt the peak prevalence for S. haematobium infection was found between 8 and 10 years[3]. Sociologic factors and water contact govern schistosomiasis infection[24]. Water contact is by far most frequent and of longest duration in children. In Egyptian males it was shown that bathing and swimming, particularly for children up to 10 years of age, constituted 50% of total

activity in water[25] and is one of the most important activities causing infection with schistosomiasis[7]. In Rhodesia it was shown that the age groups with the most exposure to water were the 4-6 and 16-25 years old[26]. In Puerto Rico it was stated that children of school age had the most water contact of any group, and that play activities accounted for 51% of exposure to water[27]. A very close correlation was found between observed contact with water and the age-prevalence of infection with S. mansoni[28]. Furthermore exposure experiments point to that there is a threshold concentration of cercariae below which there is virtually no infection[24,29]. In Egypt, it was found that the rate of infection of snails with S. mansoni (0.65%) was higher than that with S. haematobium (0.16%)[30]. This high infectivity rate may explain the sharp rise and higher peak of S.mansoni infection (Fig. 1). Socioeconomic factors were unified in the present study in the two areas examined as all the cases were children of farmers and school students. Since primary-school education is free in Egypt, there was no socioeconomic bias in the two samples.

In a previous study on the prevalence of S. haematobium,it was found that the children of traders had a lower prevalence than children of farmers[3]. Ethnic

and religious practices were found to affect the transmission of schistosomiasis[7,25,31]. These factors have minimal influence on the pediatric age group under consideration. The effect of sex on the prevalence was evident only after 10 years of age where males continued to have a higher prevalence. This difference was also observed in children[29] and in older age groups[7]. Boys have more freedom , specially after the age of 6-7 years, than girls to swim in canals and to go to filed. This habbit helps them to aquire re-infection. In Egypt, it was suggested that the life span for S. mansoni worms in the body is 3.5 years and for S. haematobium is 3.8 years[30]. Egyptian workers moving to a nonendemic area were found to loose their infection in about four and half years[32]. These observations are in concordance with our results, where after a 3 to 4 years period of changing the habbit of swimming, girls showed a lower prevalence than boys of the same age group.

The intensity of infection (measured by egg excretion counts) , increased with age . It was higher in S. mansoni infection, than in S. haematobium. Other reports on S. haematobium in children, in Egypt and in Nigeria gave comparable results[3,29]. The intensity of infection was repeatedly reported to correlate with egg counts[15,33].

For S. mansoni eggs, it was shown that they have random distribution in feces[16,17] so that a single sample taken from a single fecal specimen will provide a reasonable estimate of fecal egg count[15]. For S. haematobium eggs, the diurnal cycle in ova counts in urine[10,11,12,13,29,34] was shown to have a peak at about 12 o'clock noon. The higher intensity with increasing age suggests a continuous infection with increasing worm burden and egg excretion counts. This continuous infection depends on the water contact and on the levels of cercariae in water. For S. mansoni the rate of infection of snails in Egypt was found to be 0.65% and that for S. haematobium 0.16%[30]. The discharge of cercariae has a diurnal variation which usually coincides with the swimming period of children in canals. The cercarial output reaches its peak at about 11:00 AM- 1:00 PM and can be infective for 20 hr, unless destroyed by water turbulence by animal or plant life[35]. It was suggested that water contact represents the single most important human activity that may be directly related to the intensity of infection, and consequently, severity of disease [24,28,36].

Associated parasitic infections were found in a high percentage of all age groups, with both S. mansoni and S. haematobium infection (table 4). In S. haematobium

infection, Ancylostoma had a highere prevalence than with S. mansoni and Asceris had the reverse relation .. This difference is related to the geographic distribution of the parasites, where it is known that ascaris eggs need a more humid soil than Ancylostoma and so is more prevalent in lower Egypt. This high prevalence of mixed parasitic infections is related to the hygienic and sanitary habbits of the patients.

The anthropometric measurements and hemoglobin determination were generally slightly affected, more with S. mansoni than S. haematobium infection in comparable age groups (table 5). These results concurs with other investigations on children infected with S. haematobium[3] and S. mansoni[37], where they were only affected in heavily infected children. Exceptions were cases associated with Ancylostoma infection where the hemoglobin levels were markedly lowered and the general health affected. Hook worm infection is always associated with blood loss and marked anemia[38]. Higher intensity of S. mansoni infection may lead to more blood loss and higher morbidity in infected children. Dysenteric symptoms and blood-streaked stools were commenly reported with S. mansoni infection in children[40] and adults[39]. Furthermore, S. mansoni eggs deposited in the tissues were found to produce greater tissue damage and morbidity thanS. haematobium eggs[43].

Gastrointestinal symptoms in the form of dysentry, diarrhea and abdominal colic were the commonest manifestations with S. mansoni infection, while haematuria and dysuria were associated with S. haematobium infection. In Brazil, intermittent diarrhea was present in more than 50% of S. mansoni infected patients[51]. In Puerto Rico[52] and in St. Lucian S. mansoni patietns[42], 50% of patients complained of abdominal pain. In Egypt, dysentry. abdominal distension and colicky pain were reported to be frequent in S. mansoni infection[39,40], while hematuria and dysuria in S. haematobium infected children[3]. Bouts of diarrhea with blood were reported in Panyagoro, Uganda[41]. General weakness was a common complaint with S. mansoni infection (table 6) while it was lessfrequent with S. haematobium infection. This complaint was almost always associated with dysenteric symptoms or hepatosplenomegaly. In St. Lucian schistosomiasis mansoni patients, weakness was present in 32% of the examined cases[42], while it was present at moderate levels in infected children of the same locality[37]. In S. haematobium infection, it was only noticed with heavy infection.[3]

Hepatomegaly or hepatosplenomegaly occurred with statistically greater frequency , mainly among heavily and

moderately S. mansoni infected children than among those with S. haematobium infection. S. mansoni eggs retained in the host tissues have been shown to be a more potent polygenic agent than S. haematobium eggs, since they produce greater tissue damage[43]. Hepatomegaly is one of the prominent signs of the disease [44,45,46] and is related to the host immune response to schistosome eggs in the liver. Significant hepatomegaly was associated with heavy infection in St. Lucian children[37]. It was also related to heavy infections in Uganda[5] and in Kenya[15]. In the lightly infected group , there was no significant difference between S. mansoni and S. haematobium infected children which suggest that heavy infection is a factor in revealing the high polygenic effect of S. mansoni eggs. Controlled studies did not show difference between uninfected and mildly infected groups as far as enlarged livers[37,47]. Pathologic[48] and experimental[49] studies suggest that light infections even of some duration may be of little clinical significance. Splenomegaly has not been clearly associated with the intensity of infection in many previcus reports, because of the endemicity of malaria. In the present study malaria was not endemic, and splenomegaly was closely related to hepatomegaly, and both to high intensity of S. mansoni infection. Association

of splenomegaly with S. mansoni infection was reported in Brazil[50], in St. lucia[37] and in Kenya[15]. Splenomegly and hepatomegaly were present at a lower frequency in heavily S. haematobium infected children (table 6). Similar findings were previously reported[3]. None of the subjects in the current study was found to have jaundice, ascites, or advanced liver disease manifestations. These manifestations were reported to be uncommon in St. Lucian infected children[37]

In addition to demonstrating the prevalence of S. mansoni and S. haematobium in Egyptian children and the close relation of the irrigation system to schistosoma prevalence, this study is unique in comparing the prevalence and intensity of infection for both schistosoma species in matched age groups of children of the same geographic distribution. S. mansoni infection was detected at older ages than S. haematobium. It has a more sharp rise in prevelance with age, and a more ill effects on the general health of the patients. Hepatosplenomegaly and high morbidity were directly related to egg excretion. The public health implications of the current study are obvious. The high prevalence in children indicate that this is the age group of the population which is at risk. The bad

effects of S. mansoni infection on the general health of children, together with recent reports on increased prevalence after the construction of the High Dam is worth consideration. Measurement of intensity of infection provides valuable information for the expected morbidity.

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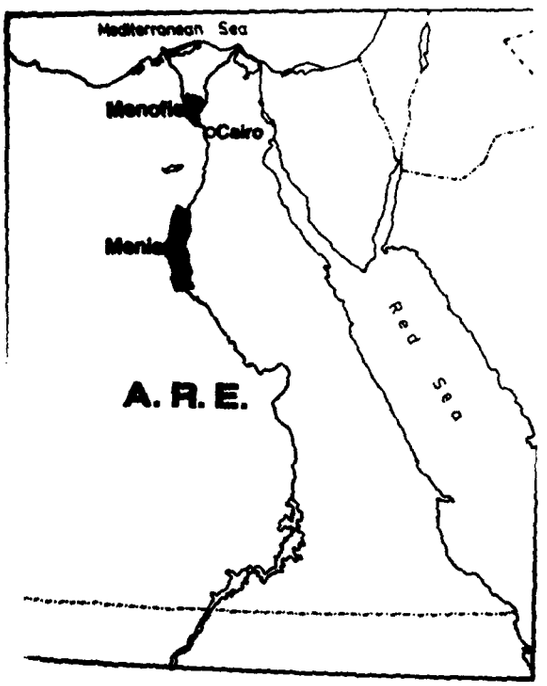
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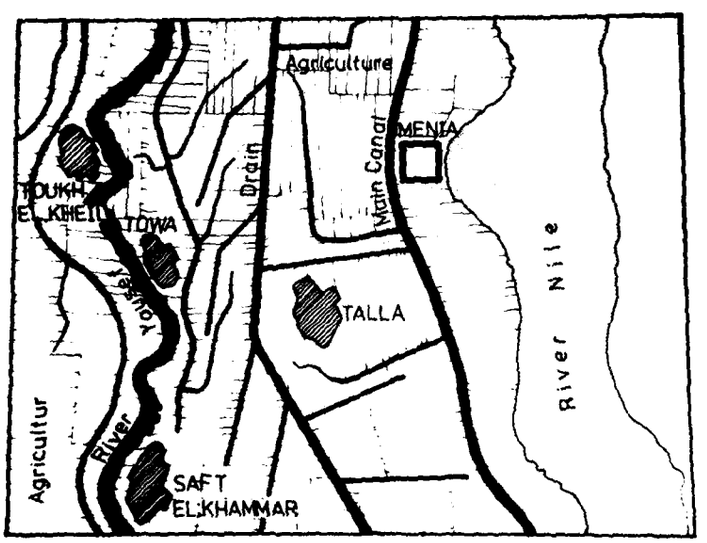
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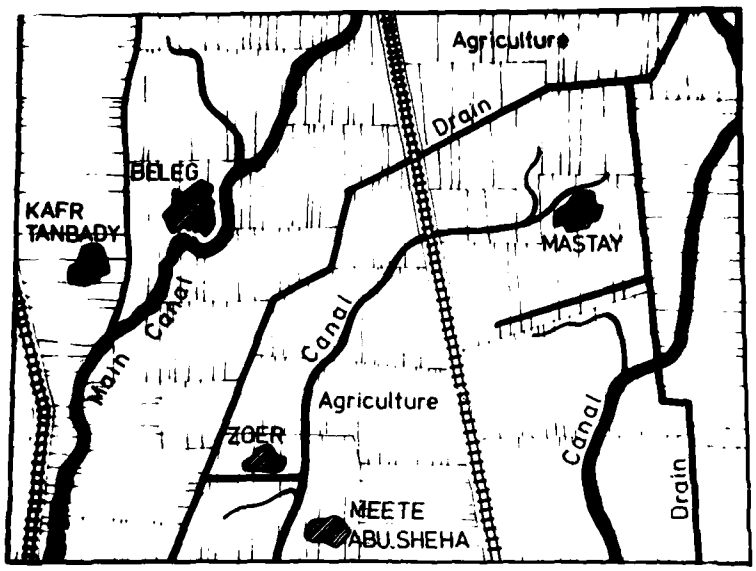
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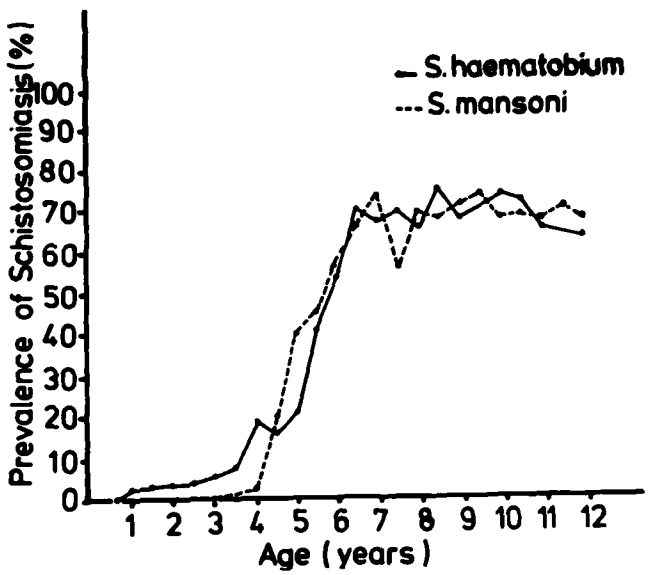
S. haematobium
S. mansoni
Prevalence of Schistosomiasis (%)
100
90
80
70
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12
Age (years)

Table 1 : Prevalence of S.haematobium in the areas with previously basin and previously perennial irrigation.

Age groups (yrs)	Previously basin		Previously Perennial	
	No.examined	% infected	No.examined	% infected
0 - 3	35	0.0	147	4.1
4 - 6	57	3.5	206	36.9
7 - 9	63	9.5	318	63.2
10 -12	45	8.9	282	56.7
Total	200	6.0*	953	46.5*

* The difference in the absolute numbers are statistically significant $P < 0.01$

Table 2 : Prevalence of S.haematobium and S.mansoni in the examined children.

Age groups (yrs)	S.haematobium		S.mansoni	
	No.examined	% infected	No.examined	% infected
0 - 3	147	4.1	115	0.7
4 - 6	206	36.9	187	31.0
7 - 9	318	63.2	313	65.2
10 -12	282	56.7	220	63.6
Total	953	46.5	835	48.3

Table 3 : Intensity of infection in S.haematobium and S.mansoni per age groups.

Age groups (yrs)	S.haematobium				S.mansoni			
	No. infected	Intensity of infection (% of infected)			No. infected	Intensity of infection (% of infected)		
		Mild	Moderate	Heavy		Mild.	Moderate	Heavy.
0 - 3	6	100.0	0	0	1	100.0	0	0
4 - 6	76	52.6	47.4	0	58	58.6	41.4	0
7 - 9	201	22.9	52.2	24.4	204	23.5	46.1	30.4
10 -12	160	24.4	48.8	26.9	140	21.4	38.6	40.0
Total	443	29.6	49.4	20.7	403	28.0	42.7	29.3

Table 4 : Parasitic infections in children infected with S.haematobium or S.mansoni.

Parasitic infections	Age groups (yrs) (% infected)							
	0 - 3		4 - 6		7 - 9		10 - 12	
	H+	M*	H	M	H	M	H	M
Enterobius	33.3	0	28.9	32.8	35.3	41.7	36.9	35.7
Ascaris	0	0	2.6	8.6	9.0	13.7	15.0	23.6
Giardia	16.7	0	10.5	15.5	23.9	19.6	8.8	7.9
Hymenolepis	0	0	2.6	3.5	8.0	10.8	6.9	10.0
Ancylostoma	0	0	0	-	8.0	4.9	10.0	5.0

+ H = S.haematobium infection * M = S.mansoni infection.

Table 5 : Anthropometric measurements and hemoglobin levels of group mean values (percent of standards**) in relation to intensity of S.heamatobium or S.mansoni infection ***

Data on	Intensity of infection					
	Mild		Moderate		Heavy	
	H+	M*	H	M	H	M
Hemoglobin, g /100 ml*	95.0	97.7	90.2	86.0	88.5	82.1
Arm eircumference as % standard	98.0	100	99.0	92.2	88.2	90.0
Skin fold thickness as % standard	92.0	4.0	90.0	93.2	85.4	70.7
Weight / Age / Hight ** (from ½ to 6 years) only	93.0	94.2	94.0	87.9	90.0	89.1

+ H = S.haematobium * M = S.mansoni.

* : Standards for haemoglobin, arm circumference and skin fold thickness are taken from a previous stydy (3).

** : Standards for weight / Age / height; are those of WHO monograph.(8)

***: Cases with ancylostoma infection were excluded.

Table 6 : Clinical Signs and symptoms in children infected with S.haematobium or S.mansoni.

Clinical signs and symptoms	% affected		Statistical significance P 0.05
	S.haematobium	S.mansoni	
Dysentry	23	84	Sig.
Diarrhea & abdominal colic	12	62	Sig.
Dysurea	87	14	Sig.
Haematuria	75	12	Sig.
General weakness	24	31	non.sig.
Pallor	28	49	non.sig.
Signs of avitaminosis	18	21	non.sig.
Hepatosplenomegaly	6	23	Sig.
Ascitis	0	0	--